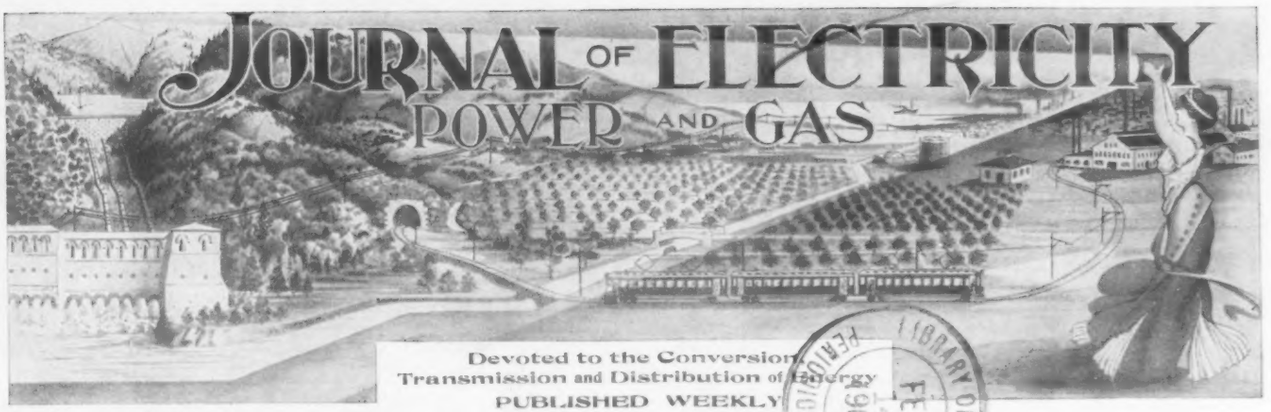

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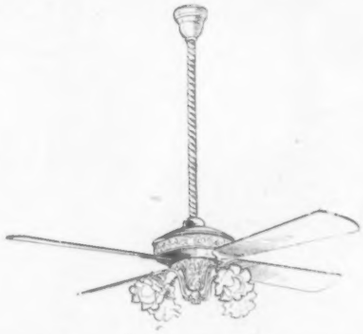

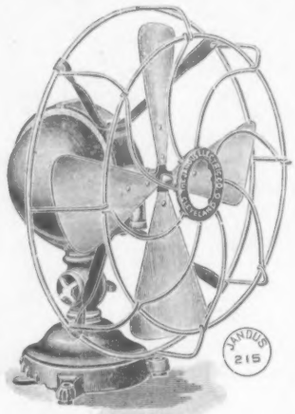

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REHABILITATION OF SAN FRANCISCO'S STREET RAILWAY SYSTEMS

By ARTHUR H. HALLORAN

So rapidly have the scars left by the great San Francisco earthquake and fire of April 18th, 19th and 20th, 1906, been healed, that already even the men who passed through those trying times are forgetting the wonderful deeds accomplished in the face of impending disaster. The comment on the heroism and courage of that stricken people in one of the greatest disasters of modern civilization, has been world wide. To-day, less than two years after, the new city bids fair to outstrip the old in the magnificence of its buildings and in the growth of its population. Most of this work has been permanently recorded in the current literature of the times, but the herculean task undertaken by the various street railway companies of San Francisco in rehabilitating and extending their wrecked car lines, remains unnoticed by the public, whose convenience is sought by these companies.

As the telling of these tasks will consist largely of an account of power-plant rebuilding and track construction, it seems fitting that this electrical journal acquaint street-railway men throughout the world with the details of how it was accomplished.

The general scheme of the article will be, first to outline the conditions prevailing before the fire, briefly recount the damage done, and then detail the work of reconstruction.

The development of street railways in San Francisco has been coincident with needs of a rapidly-growing city, from a few lines of horse-cars along the level streets to a great system of cable and electric roads. To Hallidrie is due the credit of leveling San Francisco's many hills by means of cable traction; that is to say, though the hills remain in their beauty and sightliness, the cable renders them readily accessible. Subsequently, with improvements in electric motors, electric traction has been used in all new work, and in reconstructing old lines where the hills were not too steep to be negotiated by electric cars. Naturally,

WASHINGTON AND MASON ST. POWER HOUSE AFTER FIRE.

after the fire, economical considerations were also a factor in this change, not so much because of track conditions as because of the enormous cost of immediately rebuilding the cable plants that were destroyed in the catastrophe.

There were four independent systems in operation before the fire. First, and most extensive, was the United Railroads of San Francisco, which, in 1902, had consolidated the Market Street, the San Francisco and San Mateo, the Sutter Street and the Sutro Electric Railway Companies under one management. Their lines included both cable and electric, and covered most of the San Francisco peninsula. The California Street Cable Railway Company operated cars on California, Hyde, Jones and O'Farrell Streets, from a central cable power house on California and Hyde Streets. Union Street, from the Presidio to the ferries, was served by an independent company, with a cable line. Pt. Lobos Avenue and Geary to Market Streets, was operated by the Geary Street, Park and Ocean Railroad Company, from a power house on Geary and Buchanan Streets. The equipment and reconstruction of each of these will be described separately.

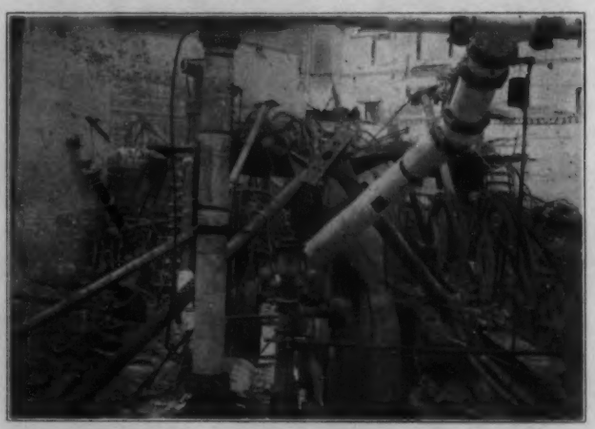
WASHINGTON AND MASON ST. POWER HOUSE BEFORE FIRE.

There were five cable power houses under the control of the United Railroads before the fire. That on the corner of Sutter and Polk operated two lines—Sutter Street, from Presidio Avenue to Market, and Polk and Larkin, out Pacific Avenue and down Ninth Street. From the Mason and Washington power house was handled all the traffic on the Sacramento, Clay, Washington, Jackson and Powell Street lines, over the steepest hills in the city. The Market Street lines, with their extensions on Haight, Valencia and Castro Streets, were controlled from the Market and Valencia Street power house. The Hayes and McAllister Street branches were each taken care of by separate stations. These power houses all consisted, essentially, of a large steam-driven reel, on which was wound a one and one-half-inch endless steel cable. Many of them also had accommodations for storing and repairing the cars, but were supplemented by several car-barns, near the line terminals. In all, there were fifty-four and one-half miles of cable road in operation.

But, whereas these cable lines had been one of the most important assets taken over from subsidiary companies by the United Railroads at the time of purchase,

SUTTER AND POLK ST. POWER HOUSE AFTER FIRE.

yet all their extensions and improvements had been with the more modern electric systems. Much of the power for these lines was taken from the high-tension lines of the California Gas & Electric Company, transmitted from their various hydro-electric plants in the Sierra Nevada Mountains. The 12,000-kilowatt gas-engine plant at Martin Station served as an important auxiliary. In addition to this, the railway company itself operated the Bryant Street and North Beach power plants. Both of these were steam-driven, the former furnishing 4,000-kilowatt direct current



INTERIOR OF WASHINGTON AND MASON ST. POWER HOUSE AFTER FIRE.

at 550 volts, to all lines south of Market, from the ferries to Thirteenth Street, and the latter, 9,600-kilowatt, 25-cycle, 3-phase alternating current, transmitted at 13,200 volts to the several sub-stations throughout the city for conversion. These sub-stations were three in number, being located at Turk and Fillmore Streets, Geneva and San Jose Avenues, and Millbrae. All lines north of Market Street were supplied with power from the sub-station at Turk and Fillmore Streets, while all south of Market, and beyond Thirtieth as far as the cemeteries, were fed from that at Geneva and San Jose Avenues. The Millbrae station

handled the suburban lines from the cemeteries to San Mateo. The total length of electric construction was two hundred miles.

From Martin Station the California Gas & Electric Corporation furnished power at 13,200-volt, 25-cycle through two lines to the Geneva Avenue station, which was in turn connected with the Turk and Fillmore Street station and

TURK AND FILLMORE SUB-STATION.

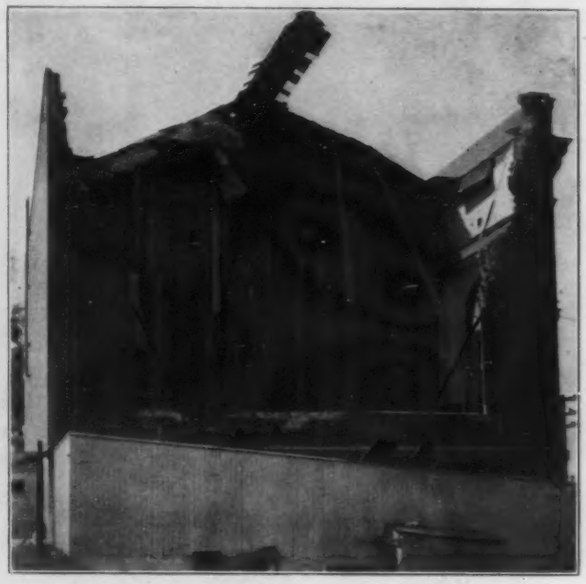
the steam plant at North Beach. Similar lines also ran from the Martin power house to the Bryant Street station, also connected with the Geneva Avenue and Turk and Fillmore sub-station.

The Turk and Fillmore Street sub-station was equipped with six 10-pole, 750-kilowatt, 600-volt, compound-wound

OIL SWITCHES AT NORTH BEACH POWER HOUSE.

rotary converters; eighteen 25-cycle, 13,200-440-volt air-blast transformers, and three blower sets with 50-inch blowers. Of the ten motor-controlled oil switches, six were connected with the rotary converters, two to the incoming and two to the outgoing lines. The Geneva Avenue station had three 6-pole, 500-kilowatt, 600-volt, compound-wound rotary converters, nine 25-cycle, 185-kilowatt, 13,200-440-volt air-blast transformers and two 50-inch blower sets. The Millbrae system was equipped with two similar converter and transformer sets. All were equipped with an up-to-date system of switch-board control.

On April 17, 1906, with the facilities just briefly detailed, the company was operating 433 cable cars and 425 electric cars, having 2,500 employees on its pay roll. The executive and engineering offices were centrally situated on the eighth floor of the Rialto Building, on the corner of New Montgomery and Mission Streets, from which radiated one of the largest systems of street railway



MILLBRAE SUB-STATION.

operation and maintenance yet devised.

On April 18, 1906, at 5:13 a. m., just as the first cars were leaving their barns, there came an earthquake shock of but a few seconds' duration, the effects of which, both immediate and subsequent, completely destroyed over one-half of this great power equipment and rendered the other

NORTH BEACH POWER HOUSE TWO WEEKS AFTER.

half entirely inoperative. The great brick stacks toppled and crashed into power plant and car barn, blocking with their debris what they had not completely crushed. Cornices and portions of the roofs crumbled under the influence of these irresistible, twisting, shaking forces, and tumbled their brick and mortar into the chaotic maelstrom. Where the power was not cut off at its source, falling poles and wires cut it off along the line of distribution. Twisted tracks twined uncertainly through the streets, in some places a subsidence of a foot or eighteen inches completely severing them. Falling chimneys and brick buildings had buried great lengths under their disintegrated ruins. Much of the rolling stock, crushed into splinters and scrap iron, was good for nothing. There was probably no single corporation that suffered so greatly in the earthquake. Most

of the damage to other industries was occasioned by the fire that immediately succeeded it. How great was this damage is shown by several of the accompanying pictures.

The tangled remains of the oil switches at the North Beach power house are only indicative of the great damage

TENTH ST. BETWEEN HOWARD AND FOLSOM.

done there. One hundred feet of the stack had careened through half the slate roof, and had been hurled, together with great steel trusses, into the delicate system of dynamos and switches. All the small piping was broken from the boilers, and one of the auxiliary oil feed-tanks badly wrenched. The economizers were entirely out of commission. Yet here, as elsewhere, the main damage was caused by the great pile of debris that blocked and choked the entrances and buried the machinery. Part of the roof at the Turk and Fillmore Street sub-

TENTH ST. BETWEEN BRYANT AND BRANNAN.

station had caved in, as had also the roof of the barn across the street. The picture of the Millbrae station speaks more eloquently than words, yet subsequently it was found that all machinery had escaped hurt except one knife switch. Similarly at Geneva Avenue the roof and some of the walls fell in. The Kentucky Street car house was badly shaken up, and eleven cars thrown into the pit. The tracks were so twisted that the cars could not be moved out until they had been repaired. At Tenth and Howard Streets the railroad building collapsed completely, and all wires were down in the street. The great generator at Martin Station was moved bodily two and one-half inches to the south. The storage holder was twisted five feet on the lower section, and twelve feet on the upper. Of the electric power stations the Bryant Street station alone was capable of furnishing current.

The cable system suffered even more than the elctric. The great brick chimneys at every station were nothing but

TAYLOR ST. BETWEEN TURK AND EDDY.

ragged stumps, whose towering superstructure had crashed through the roofs and smashed in the windows and blocked up the tracks.

The fire that then raged for two days not only destroyed much of the damage wrought by the quake, but added its own quota of destruction. From the illustration can be seen the Washington and Mason power house "before and after," in the end the building having crumbled in ruins, and the machinery converted into a tangled mass of intricately inter-

CURVE NEAR LANDS END.

laced pipe, rod, cog, spoke and cable. The engine was a complete wreck. A pile of blackened bricks had buried the Sutter Street cable machinery between the low remnants of four walls. A stack of brick and mortar marked the Valencia and Market Street power house. Nearly fifty cable cars were burned, many having been saved by pushing them by hand out of the fire zone. Even some of these were burned by further encroachments of the fire. The offices in the Rialto Building were completely gutted. The tracks in the burned district were twisted

and warped, all wooden pole supports and all eyebolt supports were gone, yet the iron poles were serviceable. The tracks along Harrison Street were entirely out of commission, as were also those on the Sixth Street and the Montgomery and Tenth Street lines.

In the aggregate, possibly the greatest damage was done to the tracks. Where they were not actually twisted and wrenched out of all semblance to their original condition by the force of the earthquake, they were rendered insecure by sinking of the ground on either side. Culverts were destroyed, and whole sections of track depressed below their former level. Debris blocked the right of way for miles. Turn-tables for the cable cars were put out of plumb, and the slots completely closed. Where fire had been, the steel was warped and burned until useless. Some of the accompanying pictures give a few instances of this damage, which was very great over many lines not mentioned.

The road beds along the Powell and Mason Streets cable lines were left in fair condition, the tracks being warped, and the slots being closed in a few places. The terminal turntables were in a sorry plight. The trolley tracks at Colma and Millbrae on the San Mateo extension were thrown out of line where filled in along the right of way. In San Mateo they were covered with debris, which was soon removed. Poles sagged, and ground gave way all along this line, which runs south along the San Francisco Peninsula, closely paralleling the zone of earthquake faulting. The line had been heavily ballasted with crushed rock, on which lay the redwood ties. A 75-lb. T-rail with cast-welded joints was used along most of the private right of way. In the redwood side pole construction those carrying high-tension wires were 7x7 inches at the top, 13x13 inches at the base, and 35 feet long, and the others 25 feet long with base 12 inches square, and 7x8 inches top. The failure was not due to poor construction, but to the great forces to which it was subjected.

The fire burned until Sunday morning, April 22nd. But long before it was put out the railway system rallied to the work of clearing the wreck and preparing for the long siege of reconstruction to follow. A commissary department was organized, and provision made for housing employes. Men were detailed to stand in the bread line to obtain food for the gangs of men who started to work almost at once, apparently oblivious of their personal losses and griefs.

The conditions thus briefly outlined were met with characteristic energy by the officials and employes of the company. By the evening of April 20th current had been turned on from the Bryant Street power house, and the following roads were completed and ready for operation as regards the overhead: Bryant Street from 11th to 26th Streets; 26th Street from Bryant to Mission Streets; Folsom Street from 16th Street to Precita Avenue; Precita Avenue, Army Street and San Bruno Avenue to Dwight Street; Mission Street from 22nd Street to Virginia Avenue; 16th, Kansas, 17th, Connecticut, 18th Streets (from Bryant to Kentucky Streets); 4th and Kentucky Streets and Railroad Avenue from Channel Street to San Mateo County; 24th Street from Howard to Rhode Island Avenue; Turk and Eddy Street from Van Ness Avenue to Devisadero Street; Devisadero from Page to Jackson, and the 16th and Fillmore line from Bryant to Broadway were also ready. On the 21st, Saturday, cars were run on the Sixteenth and Fillmore Street lines until ordered stopped by the Committee of Public Safety. The Bryant Street station furnished the power, using salt water for the boilers. In the afternoon all the cars in the 28th Street car house were taken out to San Bruno Avenue. On the same day Mission Street was clear from 16th Street to the Holy Cross Cemetery. These lines were the most important in the unburned district. At the North Beach power house there were fifty men at work on April 20th clearing the debris, and inside of two weeks' time broken steam pipes had been repaired, and the plant running, as shown in the accompanying picture.

(To be continued.)

A SINGLE-PHASE RAILWAY MOTOR.*

By E. F. Alexanderson, Electrical Engineer General Electric Company.

The various single-phase railway motors which have been developed during the past few years have been styled in general as either repulsion or as series motors.

The most prominent types of single-phase railway motors which have found commercial application are:

1. The compensated repulsion motor (Latour-Winter-Eichberg). This motor has a short-circuited armature and an extra set of brushes for producing compensation, with a view to obtaining a higher power factor.

2. The compensated series motor (Eickmeyer-Stanley-Lamme).

3. The compensated series motor with shunt-excited commutating poles (Milch-Richter). In this motor a commutating field is produced locally by coils in the stator.

The motor to be discussed in this paper is neither a series nor a repulsion motor in the generally accepted sense, but embodies the best features of both. For lack of a better name, it may be called a "series-repulsion" motor. The windings resemble those of a series motor and the armature and stator are permanently connected in series. A general diagram of the motor is shown in Figure 1. The terminal voltage of the series-repulsion motor can be selected with greater liberty than in a series motor, but not so arbitrarily as in the case of a repulsion motor.

Its advantages over the straight compensated series motor are very marked. The commutation is so radically improved that resistance leads are unnecessary and it is feasible to build the motors in larger capacities.

In its performance it resembles the series motors with commutating poles, but offers several distinct advantages over the same. Instead of producing a commutating flux locally by coils on the stator, the conductors in the armature are located in places where the desired flux will naturally exist. This arrangement simplifies the stator winding considerably. The compensating winding of the series motor is replaced by an inducing winding with twice as many turns, and the energy is introduced either in the stator alone or in the stator and rotor together. By this arrangement the starting torque is doubled for the same commutation and the same supply of current.

In the compensated repulsion motor the commutating field becomes too strong as soon as the speed appreciably exceeds synchronism, unless special arrangements are made to suppress this field locally. The motor under consideration is not limited by the synchronous speed, as the repulsion motor feature is reduced at the high speeds, and its action follows more closely the performance of a series motor; the number of poles can therefore be selected with the same liberty as in a series motor. This is of great importance for the motor characteristics, particularly in regard to weight and starting torque. Furthermore, no extra set of brushes, nor any series transformer, is required, which makes the motor equally well adapted for direct and alternating current.

The two essential conditions for perfect commutation are as follows:

1. The electromotive force of alternation of the main field should be neutralized by the electromotive force of rotation of the cross field, which is magnetized by an exciting current flowing in the armature, and serving to transfer the energy from rotor to stator.

2. The magnetomotive force of the stator should be larger than the armature reaction. The difference should be large enough to overcome the voltage due to the leakage flux. This difference is furnished by another cross field magnetized by the difference between the ampere turns of the armature and the inducing winding.

*Abstract of paper presented before the American Institute of Electrical Engineers, New York, January 10, 1908.

These conditions can be fulfilled in a series-repulsion motor at any speed without the aid of commutating poles. Instead of creating a commutating flux artificially in a place where the commutated conductors happen to be, the conductors are located in a place where the correct flux will naturally exist. By controlling the value as well as the phase of the different fluxes as described, perfect commutation can be obtained at any speed.

Figure 2 gives a comparative diagram of the alternating voltages in the short-circuited coils of a series-repulsion motor for 25 cycles, and for the same motor when used as a series motor for 15 and 25 cycles.

Starting.

The starting of a single-phase motor is materially handicapped by the fact that the alternating nature of the main field sets up currents in the armature coils which are short-circuited by the brushes. This same difficulty is experienced in all known types of single-phase commutator motors. Although the principle involved is the same in the motor under consideration, the practical result gained by the arrangement employed is a starting torque twice as high as would be possible in a corresponding series motor for the same commutation and the same supply of current.

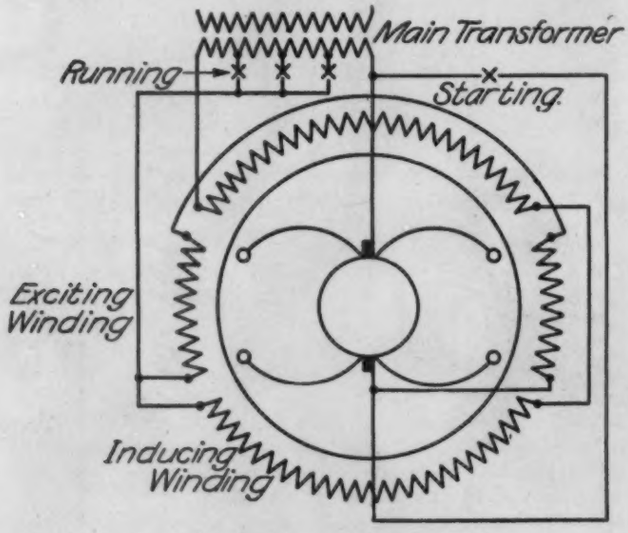


FIG. 1 THE SERIES-REPULSION MOTOR.

This double starting torque is obtained by winding the stator with twice as many turns as the armature. The motor starts as a repulsion motor with the armature short-circuited, as shown in Figure 3. The current as it enters the stator has only half the strength of that in the rotor, owing to the ratio of stator to rotor turns. The short-circuiting switch of the rotor carries only half as much current as the rotor itself, because the current in the short-circuited connection is only the difference between the stator and the rotor current. The inducing winding, the field and the armature are connected permanently in series; but with the connections shown the field is in series with the stator circuit at starting and with the rotor circuit when running. In starting, the rotor carries twice as much current as when running, in order to give the same field strength —in this manner doubling the starting torque. The sparking at starting is quite insignificant up to a certain value of the voltage short-circuited by a brush, but beyond this point the commutation rapidly becomes bad. This critical value is about the same as that which gives a reasonably good commutation in running. For a pure compensated series motor, therefore, the same remedy must be looked for in running as in starting conditions, and the natural solution is to design the motor for a low voltage or to use resistance leads.

In ordinary series motor equipments, the difficulty arises that a higher starting torque is usually required than the full-load running torque, and if the short-circuited voltage is permissible in running, it will get too high at starting. A starting torque of twice full load (one-hour rating) torque is, however, usually more than enough, and therefore the short-circuited voltages can be kept below the critical point, while the torque is increased above normal. It is, however, not only the critical value of the voltage, but also the time that such a voltage is maintained that determines what is permissible. In this respect any repulsion motor has a great advantage, because the sparking disappears altogether as soon as the armature has reached an appreciable speed. Furthermore, a voltage could be allowed in starting with a double torque which would not be permissible with normal running torque, on account of the short time-element of the starting condition.

The general principle which has been discussed for regulating the field in starting an alternating-current motor can be applied in different ways; it was first employed by Eichberg, who used a variable series transformer in the field circuit. Particular attention may, however, be called to the simplicity of the arrangement described here, where the same result is accomplished through the inherent characteristics of the motor without the use of any additional apparatus. The same principle can be applied to series motors by the use of a series transformer or some suitable controlling device, but it involves the disadvantage of doubling the current which is to be supplied to the motor through the control system, whereas when starting as a repulsion motor, increased torque is gained by local current superimposed on the main current by induction.

Control.—In regard to the practical application of the system, it may be mentioned that several four-motor equipments for alternating and direct current have been in operation for some time. The alternating-current control equipment has a total of seven contactors and a reversing switch. This gives four points

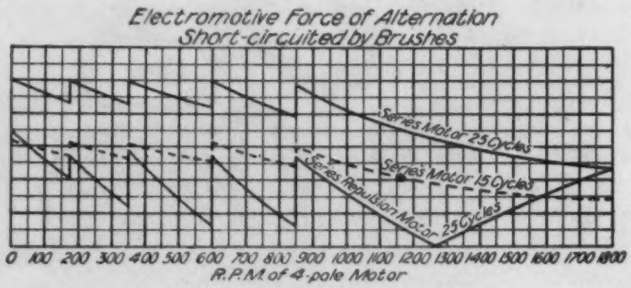

Electromotive Force of Alternation
Short-circuited by Brushes
Series Motor 25 Cycles
Series Motor 15 Cycles
Series Repulsion Motor 25 Cycles
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
R.P.M. of 4-pole Motor

FIG. 2.

on the controller which seems quite satisfactory for motor-car operation, though any number of steps can be added to take care of locomotive operating conditions.

The preferred method of control is the one shown in Figs. 3 and 4. In starting, the armature is short-circuited and the full secondary voltage of the transformer is impressed upon the inducing and exciting windings. The current flowing through the stator continues through the armature, but due to the ratio of turns of inducing winding and armature winding, an additional current of equal strength to the stator current flows through the local circuit of the armature and the short-circuited connection. In the running connection, part of the power is introduced in the stator and part in the rotor, and the field winding carries the same current as the armature; that is, twice the stator current, thus giving a relatively greater field strength than in the starting condition, just as it would be produced by a series-multiple connection of the field winding.

Although the total potential impressed upon the stator and rotor is the same for starting and running, the result of changing the connection so as to transfer the energy input from the stator to the rotor has the effect of increasing the resulting voltage of the motor. This is due to the ratio of transformation between stator and rotor. In this manner a higher speed is obtained by impressing a higher resulting voltage, and the same change of connections makes the motor adapted for a higher speed by changing the ratio of series and repulsion motor action.

The only motor that has an inherent claim on unity power-factor is the direct-current motor. In every alternating-current motor a certain amount of wattless volt-amperes is consumed in magnetizing the field, and in leakage, so that the maximum torque is limited to a lower value than it is with the direct-current motors. An alternating-current motor with inherently good power-factor is one with high overload capacity, and this must be due to a comparatively small proportion of volt-amperes being consumed for magnetization. There are, however, artificial methods of bringing the power-factor of the alternating-current motor up to unity.

A series repulsion motor as developed for railway service has only one-third to one-quarter repulsion motor action, this being the proportion that gives sparkless commutation from synchronous to double synchronous speed. The lowering of the power-factor due to magnetizing current is therefore very slight, and with the greater liberty in design that is gained in the series repulsion motor, the power-factor is practically the same as in a series motor.

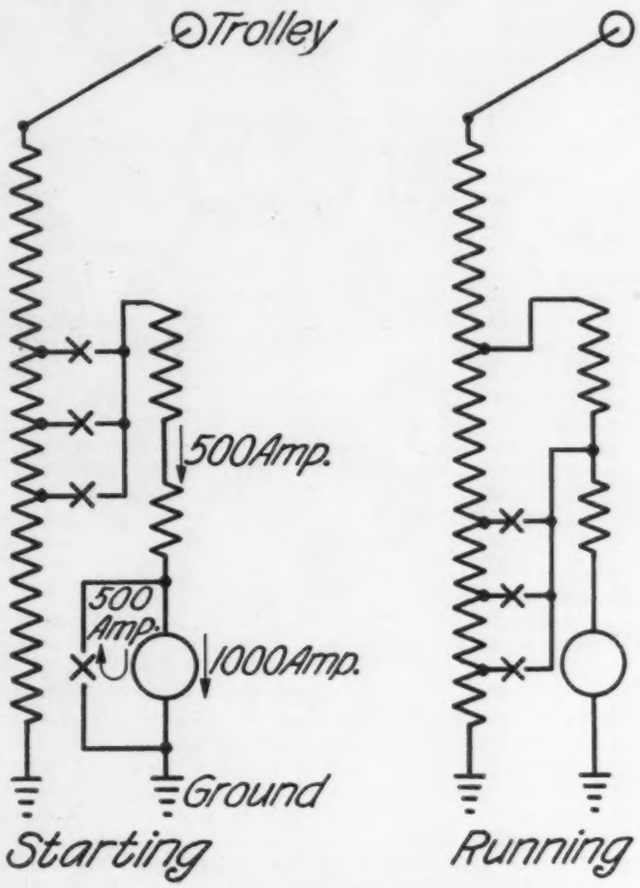
The analysis of the phase displacement also indicates how the power-factor can be corrected by shifting back the phase of the field current. This can be done in the series repulsion motor as well as in the series motor by shunting the field by a resistance according to the suggestion of Mr. A. S. McAllister. It can also be done, as has been experimentally demonstrated, by a slight degree of separate excitation of the field derived from the main transformer or from the stator coils. However, any raising or lowering of the power-factor of phase displacement does not affect the tractive effort or heating of the motor; it only changes the voltage that has to be applied in order to overcome the inductive drop. As soon as any artificial method of raising the power-factor involves any complication, for instance, another set of brushes on the commutator, it will probably prove preferable to improve the constants of the system by using synchronous machines wherever power is used for other purposes.

Resistance leads.—The use of resistance leads, which has been so much discussed, has been found to be unnecessary in motors of the type described. Certain motors which have been operated for a considerable time as series motors, and then rewound so as to embody the features described in this paper, have shown an increased life of brushes and commutator up to the standard of good direct-current practice. The improvement in commutation was so great that it was possible at the same time to increase the thickness of the brush and the output of the motor.

Selection of frequency.—In regard to choice of frequency, the series repulsion motor again gives greater liberty. Whereas the starting torque can be doubled on either 15 or 25 cycles, it may be mentioned that a series motor which was almost inoperative at a certain load at 25 cycles, after rewinding, as described, was tested as a series repulsion motor, and found to give excellent commutation at 40 cycles, at the same load. It can therefore be said in general that 25 cycles is entirely satisfactory for all geared motor work; it is preferable in that the combination of motor and transformer weighs less than at 15 cycles.

Economy of material.—The motor described can be built in larger capacities than the series motor. The principal reason for this is the inherently good commutation and increased starting torque which make resistance leads unnecessary, thereby eliminating the heat generated by the resistance leads, and also gaining space in the slots, which can be used for copper. Furthermore, it is possible to increase the flux per pole without impairing the commutation.

The fractional pitch winding which is used primarily for the sake of commutation is also advantageous from the point of view of economy of material. The saving extends not only to the end-connections, as is the case with the fractional-pitch induction motors, but also to the stator winding, inasmuch as only the active armature conductors, or only about 80 per cent of the total, need to be compensated for; whereas with the full-pitch armature, the entire winding must be compensated for. In neither case is it possible to utilize more than about 80 per cent of the total pitch as effective pole arc, because of the space occupied by the field winding. This principle is applicable to any type of compensated machine of the Deri type for alternating or direct current, except when the commutating pole is used. The fact that the number of poles in the series-repulsion motor can be selected without regard to the synchronous speed is an important consideration.



FIGS. 3 AND 4. THE SERIES-REPULSION MOTOR.

In summing up the preceding the particular advantage of the motor described may be claimed to be:

1. Good commutation at all speeds without the use of resistance leads.
2. Larger capacities possible than with the series motor.
3. High tractive effort possible, due to the liberty of selecting the number of poles.
4. Increased starting torque, possible because of the inherent ratio of winding turns, without supplying an increased current from the main transformer.
5. Simplicity of construction. The stator is the same as in the series motor, in fact easier to construct, due to the greater liberty of placing the field-winding in slots. The armature is constructed according to standard direct-current practice with the conductors soldered into the commutator bars.
6. Equally well applicable to direct and alternating current.

EFFECTS OF LIGHT UPON THE EYE.*

By Dr. H. H. Seabrook.

Illumination for near work is in a most unsatisfactory state. Our country leads the world, apparently, in the brilliancy of its artificial illumination, and certainly leads the world in ocular exhaustion, discomfort and congestion. When gas came into general use, these troubles began to increase, and a further increase was in evidence as the incandescent electric lamp came more and more into fashion. Both here and abroad, oculists agree that the kerosene burner is the least harmful artificial illuminant. They might leave the word artificial out with propriety, for no damage has been traced to kerosene light. The most satisfactory light is, no doubt, daylight (not sunlight), a few feet within a closed window, on a bright day. In this light, finer lights and shadows and delicate colors may best be distinguished by healthy eyes. A greater distance from the source of light diminishes vision, and even taking away the protection of the window glass causes more dazzling and decreased retinal endurance. The adaptability of the eye is small for increased illumination, and the limit of increase of vision with stronger light is within the medium limit of illumination. The light should come from the rear and left, and fall upon the object. If the latter has a glazed surface which reflects white light, fatigue is more rapid than with a dull surface, for below the surface of objects chemical rays are absorbed, and color and visibility is due to that portion of the white light which is not absorbed but returned to the eye from below the surface.

Analyses of light, as published, are difficult to comprehend by one who is ignorant upon the subject. Daylight, or sunlight, is a variable standard to take without further definition or explanation of the conditions. Meyer's analysis, as given by Cohen, has violet in the electric (arc) light as .3 to daylight 1, and as given by Staerkle, 1. An analysis published by the Acetylene Company gives for the violet in the arc light 1 to 1 for sunlight. Staerkle gives, for gas, violet, .1; Cohen, .3; the Acetylene Company, 1.15. Let us suppose that one table, giving the kerosene burner as very weak in violet rays, is correct, and another with ostensibly the same standard, omitting kerosene, is correct in giving the electric incandescent lamp what is meant to be the discredit of the weakness in violet rays as compared to the other illuminants; we must then look for contributory causes which have caused the incandescent lamp to give rise to more chronic eye degeneration and disturbance than any other light used for near work. Acetylene may be thrown out on account of lack of opportunity for much damage. The image of the brilliant filament of the incandescent lamp, with its concentration of light, must harm the retina more than the more diffuse images of flames; the benefit from ground glass globes for this light, when the eyes are exposed to its direct rays, must be partly due to diffusion of the light. Without ground glass, this light is more steadily brilliant than kerosene, gas, or the gas mantle burner, and there is less chance for retinal recuperation. Ground glass reduces all the rays of the light about twenty-five per cent. In searching for other causes of trouble, we note that the movable kerosene lamp may be, and is usually placed in a good position to illuminate the object, while the incandescent electric lamp is usually not well placed, often in offices being rigidly fixed so that either the eyes must be subject to direct light, or the head must be bent forward for work, congesting the eyes. No amount of green on a tin shade will correct this improper permanent position of the lamps. Again, we notice how very thin the glass bulb of the incandescent is compared with the lamp chimney, and since glass of five millimeters thickness absorbs twenty-nine per cent of the chemical rays of sunlight at an angle of sixty degrees (Hankel), we conclude we have another element of trouble, as chemical rays are absorbed by glass in proportion to its thickness.

The Welsbach mantle changes the ordinary gas flame, with its marked excess of red, to a cold light, deficient in that color. It is less irritating to some eyes than other lights, but more irritating to others.

Many substances absorb chemical rays and allow luminous rays to pass. For practical purposes, there seems no need to consider any of them except glass as a protection for the eyes from the intrinsic brightness of too intense light. Neither does there seem any question that yellow is the color to choose to conserve or improve vision and protect the eyes from the chemical action of light. Globes may be used of pink, orange, red, or green, as desired, when the light may be diminished in luminous qualities. It is best to choose for protective purposes that shade of yellow which appears in the best ray filters or is shown in the glass used for modifying the light of developing rooms for photographic plates. This amber yellow may be darkened by a brown admixture for weak or diseased eyes, or unusual light exposure. It is difficult to manufacture without imperfections, and the supply slowly follows the demand.

That the study of illumination for practical purposes is difficult, no one will deny. The difficulty of conveying knowledge about light, even if one possesses it, must be great, for there is no definite language, as of medicine, for instance. Newton first separated light into primary colors, and he also advocated the corpuscular theory of Descartes; and after more than two centuries we use Newton's language and speak of chemical rays in order to be understandable, and compound such sentences as "Since the wave lengths at the violet end of the spectrum are but half the length of those at the red, twice as many chemical rays as heat rays, from white light, enter the eye during the same period of time." When we speak of light in general, we usually mean light with infra-red, spectral and ultra-violet effects. Light rays may mean the visible spectrum, or the luminous yellow. The expression primary colors has just been used. It meant, then, the seven colors to be distinguished in the spectrum by many eyes, or the six that can be recognized by the others. It is frequently applied to the fundamental pigment colors, red, yellow and blue, from which all other pigment colors may be produced by mixing; or the fundamental spectral colors, red, green and violet.

Illuminating engineers are not entirely satisfied with standards of measurement of light; they would be still more confused if the visual standards which oculists have used for many years should be presented to them. Vision for distance only has been considered, and the apparent contradictions in facts, the long descriptions of investigations by Germans, often followed by conclusions entirely at variance with the premises, the conclusions of others, especially Americans, upon no premises at all, make "laws," as they were formerly called in these studies, rather difficult to formulate. In the present instance, you are asked to believe what many of you already know, that the desire for intensity of light has been already overdone as regards the good of the eyes. The small but increasing portion of the consumers who wish a light that is soft to the eyes, ought to be encouraged.

*Abstract from a paper read before the New York Section, Illuminating Engineering Society.

STANDARD MOONLIGHT SCHEDULES FOR 1908.

Compiled for mean local time, latitude 40°.

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out
1	5.15 P.M.		5.45 P.M.		6.20 P.M.		6.50 P.M.		7.20 P.M.		7.50 P.M.	
2	5.15 "	6.25 A.M.	5.45 "	6.10 A.M.	6.20 "	5.35 A.M.	6.55 "	4.45 A.M.	7.25 "	4.00 A.M.	7.50 "	3.35 A.M.
3	5.15 "	6.25 "	5.50 "	6.10 "	6.20 "	5.35 "	6.55 "	4.45 "	7.25 "	4.00 "	10.20 "	3.35 "
4	5.15 "	6.25 "	5.50 "	6.10 "	6.25 "	5.30 "	6.55 "	4.40 "	7.25 "	4.00 "	10.50 "	3.35 "
5	5.15 "	6.25 "	5.50 "	6.10 "	6.25 "	5.30 "	10.30 "	4.40 "	11.00 "	4.00 "	11.20 "	3.35 "
6	5.15 "	6.25 "	5.50 "	6.10 "	6.25 "	5.30 "	11.25 "	4.40 "	11.40 "	3.55 "	11.50 "	3.35 "
7	5.15 "	6.25 "	10.45 "	6.05 "	10.40 "	5.30 "	——	4.35 "	——	3.55 "	——	3.35 "
8	9.40 "	6.25 "	11.50 "	6.05 "	11.40 "	5.25 "	12.15 A.M.	——	12.20 A.M.	——	12.15 A.M.	——
9	10.50 "	6.25 "	—— "	6.05 "	——	5.25 "	1.00 "	4.35 A.M.	12.50 "	3.55 A.M.	12.40 "	3.35 A.M.
10	11.50 "	6.25 "	12.50 A.M.	——	12.40 A.M.	——	1.45 "	4.35 "	1.20 "	3.55 "	1.05 "	3.35 "
11	——	6.25 "	1.50 "	6.05 A.M.	1.30 "	5.20 A.M.	2.20 "	4.35 "	1.50 "	3.55 "	2.30 "	3.35 "
12	12.55 A.M.	——	2.45 "	6.00 "	2.20 "	5.20 "	2.50 "	4.30 "	2.15 "	3.50 "	No light.	3.35 "
13	1.55 "	6.25 A.M.	3.45 "	6.00 "	3.00 "	5.20 "	No light.	4.30 "	2.40 "	3.50 "	No light.	No light.
14	2.55 "	6.20 "	4.25 "	6.00 "	3.45 "	5.15 "	No light.	No light.	No light.	3.50 "	No light.	No light.
15	3.55 "	6.20 "	No light.	5.55 "	No light.	5.15 "	No light.	No light.	No light.	No light.	7.55 P.M.	No light.
16	4.50 "	6.20 "	No light.	No light.	No light.	No light.	No light.	No light.	No light.	No light.	7.55 "	9.50 P.M.
17	No light.	6.20 "	No light.	No light.	No light.	No light.	7.10 P.M.	No light.	7.35 P.M.	No light.	8.00 "	10.50 "
18	No light.	No light.	6.05 P.M.	No light.	No light.	No light.	7.10 "	8.50 P.M.	7.40 "	10.00 P.M.	8.00 "	11.40 "
19	No light.	No light.	6.05 "	7.55 P.M.	6.40 P.M.	No light.	7.10 "	10.00 "	7.40 "	11.00 "	8.00 "	12.20 "
20	5.30 P.M.	No light.	6.10 "	8.55 "	6.40 "	8.50 P.M.	7.10 "	11.00 "	7.40 "	12.00 M.	8.00 "	1.00 "
21	5.30 "	8.05 P.M.	6.10 "	9.55 "	6.40 "	9.50 "	7.10 "	12.10 A.M.	7.40 "	1.00 A.M.	8.00 "	1.30 "
22	5.35 "	9.05 "	6.10 "	10.55 "	6.40 "	11.00 "	7.15 "	1.15 "	7.40 "	1.40 "	8.00 "	2.00 "
23	5.35 "	10.00 "	6.15 "	12.00 M.	6.45 "	12.00 M.	7.15 "	2.20 "	7.45 "	2.20 "	8.00 "	2.25 "
24	5.35 "	11.00 "	6.15 "	1.00 A.M.	6.45 "	1.10 A.M.	7.15 "	3.00 "	7.45 "	2.50 "	8.00 "	2.55 "
25	5.35 "	12.00 M.	6.15 "	2.10 "	6.45 "	2.15 "	7.15 "	3.40 "	7.45 "	3.20 "	8.00 "	3.25 "
26	5.40 "	1.00 A.M.	6.15 "	3.15 "	6.45 "	3.15 "	7.15 "	4.10 "	7.45 "	3.40 "	8.00 "	3.30 "
27	5.40 "	2.10 "	6.15 "	4.25 "	6.50 "	4.10 "	7.20 "	4.10 "	7.45 "	3.40 "	8.00 "	3.35 "
28	5.40 "	3.15 "	6.15 "	5.25 "	6.50 "	4.55 "	7.20 "	4.10 "	7.45 "	3.40 "	8.00 "	3.35 "
29	5.40 "	4.25 "	6.20 "	5.35 "	6.50 "	4.50 "	7.20 "	4.05 "	7.45 "	3.35 "	8.00 "	3.35 "
30	5.45 "	5.35 "		5.35 "	6.50 "	4.50 "	7.20 "	4.05 "	7.50 "	3.35 "	8.00 "	3.35 "
31	5.45 "	6.15 "			6.50 "	4.50 "		4.05 "	7.50 "	3.35 "		3.35 "
1		6.10 "				4.45 "				3.35 "		

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out
1	8.00 P.M.		7.45 P.M.		8.35 P.M.		8.30 P.M.		10.30 P.M.		11.55 P.M.	
2	8.00 "	3.35 A.M.	9.10 "	3.55 A.M.	9.10 "	4.25 A.M.	9.20 "	4.55 A.M.	11.40 "	5.25 A.M.	——	6.00 A.M.
3	9.50 "	3.35 "	9.40 "	3.55 "	9.50 "	4.25 "	10.20 "	4.55 "	——	5.30 "	1.05 A.M.	——
4	10.20 "	3.35 "	10.05 "	4.00 "	10.35 "	4.25 "	11.30 "	4.55 "	12.55 A.M.	——	2.15 "	6.00 A.M.
5	10.40 "	3.35 "	10.35 "	4.00 "	11.30 "	4.30 "	——	5.00 "	2.10 "	5.30 "	3.25 "	6.05 "
6	11.10 "	3.35 "	11.10 "	4.00 "	——	4.30 "	12.45 A.M.	——	3.20 "	5.30 "	4.35 "	6.05 "
7	11.35 "	3.35 "	11.55 "	4.00 "	12.40 A.M.	——	2.00 "	5.00 A.M.	No light.	5.30 "	No light.	6.05 "
8	——	3.35 "	——	4.00 "	1.50 "	4.30 A.M.	3.15 "	5.00 "	No light.	No light.	No light.	No light.
9	12.05 A.M.	——	12.50 A.M.	——	3.05 "	4.30 "	No light.	5.00 "	No light.	No light.	No light.	No light.
10	12.40 "	3.35 A.M.	1.50 "	4.00 A.M.	No light.	4.35 "	No light.	No light.	5.20 P.M.	No light.	5.05 P.M.	No light.
11	1.20 "	3.40 "	No light.	4.00 "	No light.	No light.	6.00 P.M.	No light.	5.20 "	7.40 P.M.	5.05 "	8.05 P.M.
12	2.10 "	3.40 "	No light.	No light.	6.45 P.M.	No light.	6.00 "	7.50 P.M.	5.20 "	8.30 "	5.05 "	9.00 "
13	No light.	3.40 "	7.30 P.M.	No light.	6.45 "	8.55 P.M.	5.55 "	8.30 "	5.20 "	9.20 "	5.05 "	10.00 "
14	No light.	No light.	7.30 "	9.20 P.M.	6.45 "	9.25 "	5.55 "	9.10 "	5.15 "	10.20 "	5.05 "	11.00 "
15	8.00 P.M.	No light.	7.30 "	9.55 "	6.40 "	10.00 "	5.55 "	9.50 "	5.15 "	11.20 "	5.05 "	12.00 M.
16	8.00 "	10.20 P.M.	7.30 "	10.30 "	6.40 "	10.35 "	5.50 "	10.40 "	5.15 "	12.15 A.M.	5.05 "	1.00 A.M.
17	8.00 "	10.55 "	7.25 "	10.55 "	6.40 "	11.15 "	5.50 "	11.35 "	5.15 "	1.15 "	5.05 "	2.00 "
18	8.00 "	11.30 "	7.25 "	11.30 "	6.35 "	12.00 M.	5.50 "	12.30 A.M.	5.15 "	2.15 "	5.05 "	3.00 "
19	7.55 "	12.00 M.	7.25 "	12.00 M.	6.35 "	12.50 A.M.	5.45 "	1.30 "	5.15 "	3.15 "	5.05 "	4.00 "
20	7.55 "	12.25 A.M.	7.20 "	12.40 A.M.	6.35 "	1.45 "	5.45 "	2.30 "	5.15 "	4.15 "	5.05 "	5.00 "
21	7.55 "	12.55 "	7.20 "	1.20 "	6.30 "	2.40 "	5.45 "	3.30 "	5.10 "	5.15 "	5.05 "	6.10 "
22	7.55 "	1.25 "	7.20 "	2.05 "	6.30 "	3.40 "	5.45 "	4.25 "	5.10 "	5.20 "	5.05 "	6.15 "
23	7.55 "	2.00 "	7.20 "	2.55 "	6.30 "	4.40 "	5.40 "	5.15 "	5.10 "	5.50 "	5.05 "	6.15 "
24	7.55 "	2.40 "	7.15 "	3.50 "	6.25 "	4.45 "	5.40 "	5.15 "	5.10 "	5.50 "	5.05 "	6.15 "
25	7.55 "	3.20 "	7.15 "	4.20 "	6.25 "	4.45 "	5.40 "	5.20 "	5.10 "	5.50 "	5.10 "	6.20 "
26	7.50 "	3.50 "	7.15 "	4.20 "	6.25 "	4.50 "	5.35 "	5.20 "	5.10 "	5.50 "	5.10 "	6.20 "
27	7.50 "	3.50 "	7.10 "	4.20 "	6.20 "	4.50 "	5.35 "	5.20 "	5.10 "	5.50 "	5.10 "	6.20 "
28	7.50 "	3.50 "	7.10 "	4.20 "	6.20 "	4.50 "	5.35 "	5.20 "	8.20 "	5.50 "	9.45 "	6.20 "
29	7.50 "	3.50 "	7.10 "	4.20 "	6.20 "	4.50 "	5.35 "	5.20 "	9.30 "	6.00 "	10.55 "	6.20 "
30	7.50 "	3.55 "	7.10 "	4.20 "	7.45 "	4.50 "	8.15 "	5.25 "	10.45 "	6.00 "	——	6.20 "
31	7.45 "	3.55 "	8.05 "	4.25 "		4.55 "	9.20 "	5.25 "		6.00 "	12.05 A.M.	——
1		3.55 "		4.25 "				5.25 "				6.20 A.M.

For lighting time, read opposite date desired, under column Light. For extinguishing time, read opposite date of next morning under column Out. Make usual addition or subtraction for standard time. Time change for other latitudes in United States not important, though computation may be readily made.

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VOL. XX FEBRUARY 8, 1908 No. 6

EDITORIAL.

As a people, we are impatient of post-mortems. The reviving of the skeletons left by the San Francisco earthquake and great fire is not a popular procedure to the present San Franciscan, who has buried the past under the progressive present and promising future of the new city. In this issue, we show a few views of the damage wrought, simply as a comparison to be subsequently made by the many pictures of what has been accomplished in the rehabilitation of the city's street railway systems. There cannot be an effect without a cause, and there cannot be improvement without a need for it. We are now illustrating this need in order to emphasize the rapid progress made in its fulfillment. The story to come will be largely a technical description of track laying and building construction, enlivened by the indomitable spirit of a plucky people united for the common good of their commonwealth.

ILLUMINATING ENGINEERING.

The appearance of a new periodical for the illuminating engineer in England, long noted for its conservatism, emphasizes the rapid progress being made by this new science of light. Or should we not say art? For art is applied intelligence, while science is but systematized knowledge. True, science relates to something to be known, and there surely is much yet to be known about correct artificial lighting, not only in its more efficient production, but also in its less wasteful use. We know of no other gradual evolution of knowledge that more closely follows the steps of scientific progress delineated by Herbert Spencer, from the time of the cave dweller, with his bright, blazing pitch-pine torch, down to the present, with its brilliant incandescence, dispelling the darkness of ignorance and fear.

What we know of illumination has been taught us by the science of optics, of chemistry, of physics, and of electricity, that have continually supplied the art of artificial lighting with better materials and more perfect instruments. These are so closely interdependent that it is difficult to separate the primary. But, insomuch as light depends on the eye for its perception, and is capable of reflection, refraction, dispersion and interference, and as these phenomena have been classified by the science of optics, this is fundamentally the most important. Chemistry has likewise been indispensable, what with its analysis of oil and of coal and water-gas, its synthesis of calcium carbide for the commercial acetylene flame, its discoveries of the properties of the rare earths, as applied to incandescent mantles, and its metallurgical refinements in the production of the new metallic filaments. Physics, in its measurement of light intensity, is likewise closely intercorrellated with these two, while electricity's role is so well recognized as to require no comment. The demands of this art have urged science on to ever higher developments in striving for perfection.

The appropriateness of this appellation as demonstrated in its industrial or mechanical sense is likewise evident in its esthetic meaning, as embodied in the artistic lighting fixtures now designed. Thus does this term imply a duality of utility and of beauty.

If there is art, there must be artisans and artists to apply it. Yet the wide field of knowledge requisite for proper directive application raises its intelligent utilization above the manual training of a mere trade almost to the level of a profession. For this aristocracy of learning, whose prerogatives for ages were assumed by priest, lawyer and doctor, has recently been successfully invaded by the engineer. This is recognized by the Standard dictionary in its definition of a profession as "an occupation that properly involves a liberal education or its equivalent, and mental rather than manual labor, hence any calling involving special mental and other attainments or special discipline, as editing, engineering, acting, authorship, etc."

The doctor as the oculist has long known the danger that threatens our eyes in poorly lighted homes, schools and work places. The physiologist has shown us the structure of the eye and the effect on it of various light intensities and colors. But, as usual, it has been left to the engineer to solve the problem. Properly, too, for is not the engineer concerned with the conversion of energy into power, and is not light a manifestation of radiant energy measured by candlepower?

Nevertheless the principles of scientific illumination are simple and easily understood. The societies recently formed in this country and abroad are disseminating this knowledge among their members, and it will be but a short time before all lighting installations will be under the direction of a competent authority. The skilled workmen now engaged in this business require only the instruction of the architect or engineer to insure satisfactory lighting.

RESOLUTIONS ON FOREST PRESERVATION.

Adopted by the Board of Directors of the A. I. E. E., January 10, 1908.

Whereas, The American Institute of Electrical Engineers recognizes that water powers are of great and rapidly increasing importance to the community at large, and particularly to the engineering interests of the country; and,

Whereas, The value of water powers is determined in great measure by regularity of flow of streams, which regularity is seriously impaired by the removal of forest cover at the headwaters with the resulting diminution in the natural storage capacity of the watersheds, this impairment frequently being permanent because of the impossibility of re-forestation, owing to the destruction of essential elements of the soil by fire and its loss by erosion; therefore

Be it Resolved, That it is the opinion of the American Institute of Electrical Engineers that the attention of the National and State Governments should be called to the importance of taking such immediate action as may be necessary to protect the headwaters of important streams from deforestation, and to secure through the introduction of scientific forestry and the elimination of forest fires the perpetuation of a timber supply; and further

Be it Resolved, That the Committee of Forest Preservation be instructed to communicate these resolutions to all members of Congress, and to the Governors of all the States.

BOOKS RECEIVED.

A "Standard Handbook for Electrical Engineers" lives up to the full measure of excellence implied in its name. It covers the entire field of electrical engineering, from a complete presentation of the various units, properties and measurements of electrical circuits, through a discussion of magnets, transformers, generators, motors and batteries to the central station. After tracing the methods of transmission and distribution of the current, the collaborators have shown the details of its application to illumination, traction, chemistry, telephony, telegraphy, and miscellaneous uses. Sections on wiring and standardization rules, together with tables and statistics, conclude the book. The high professional standing of each of the specialists who have written each of the twenty sections, precludes any criticism of the material they have presented, and it is only in a few of the minor details that the carping critic can find fault. Naturally, much that appears here has been printed many times elsewhere, excepting those sections devoted to electric traction and electro-chemistry, which contain considerable new material. But the convenience of having the opinion of the leaders as to what is most important in each of their individual fields condensed into one handy volume, greatly offsets this. The numerous diagrams and curves are clearer and more concise in illustrating the information to be conveyed than would be photographs or involved verbiage. The great deficiency of a proper index, usually found in engineering books, has here been corrected in the fifty-four pages of alphabetical and topical reference, giving ready access to the subject sought. The material is nearly as much down-to-date as is that in the technical press. Last, and not least, important is the excellent binding of the thin pages that make up this condensed book. The forty-eight pages that are used to separate the various sections throughout the volume should be omitted, to reduce its size slightly. But, with so much to praise and so little to condemn, it will soon be found indispensable by all progressive electrical engineers. Its price is $4.00, and is published by the McGraw Publishing Company, of New York City.

PERSONAL.

P. J. Aaron, Seattle manager of the Western Electric Co., was in San Francisco during the past week.

Richard Spencer, manager of the California Electrical Company, of Los Angeles, has been in San Francisco during the past few days.

Clem A. Copeland, of Los Angeles, is in San Francisco on a short business trip, with the view of expanding his business in this direction. He and his father built the first electric light power plant in Southern California.

Mr. William W. Power has been appointed manager of the electrical department of the Boston branch of the H. W. Johns-Manville Company. He was formerly district manager of the Allis-Chalmers Company's Philadelphia office, and previous to that he was connected with the Christensen Engineering Company, as special representative throughout New England States. When that company was reorganized and made the National Electric Company, Mr. Power continued with the latter concern until he became associated with the Allis-Chalmers Company.

Mr. R. H. Mansfield, Jr., Secretary of the Cutler-Hammer Manufacturing Company, of Milwaukee, Wisconsin, has been in San Francisco for the past week in the interest of his company. The Cutler-Hammer Company intends to either establish an office in San Francisco and carry a full line of their apparatus, or perfect arrangements with one of our manufacturers' agents to handle their line and carry a stock. Mr. Mansfield is making many friends for his house by his genial and pleasant manner. In a short interview with a "Journal" man, we were pleased to note his expressions of surprise at the great progress that has been made in the rebuilding of San Francisco. He expressed the belief that this field deserved the most careful attention from the Eastern manufacturers. Mr. Mansfield is visiting the Northwest, and will again visit San Francisco on his way home via Los Angeles. The "Journal" congratulates the concern that secures this agency, as the Cutler-Hammer Manufacturing Company manufacture a line of controllers that are sold to every manufacturer of dynamos in the United States.

TRADE CATALOGUES.

"Lifting Magnets and Recent Improvements in Them," is the title of a little booklet just issued by the Cutler-Hammer Clutch Co., of Milwaukee, makers of lifting magnets and magnetic clutches. The subject-matter of this booklet originally appeared in "Cassier's Magazine," for October, 1907, which is now out of print. This little booklet, which is printed in the form of a miniature magazine, traces briefly the development of the lifting magnet, illustrates the different kinds of magnets used for handling pig iron, metal plates and other classes of material, and explains, by an easily-understood analogy, how the magnetic "lines of force" support weights ranging from one to ten tons.

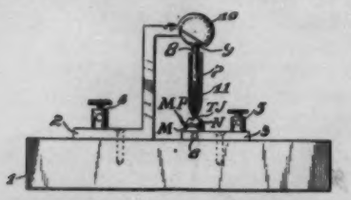
TRADE NOTE.

The Northern Electrical Mfg. Company, Madison, Wisconsin, announces the removal of its St. Paul office from 21 East Fifth Street to 516 Endicott Building, St. Paul. Mr. F. E. Drohan is in charge of the new office.

PATENTS

MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES. 877,451. Greenleaf W. Pickard, Amesbury, Mass.

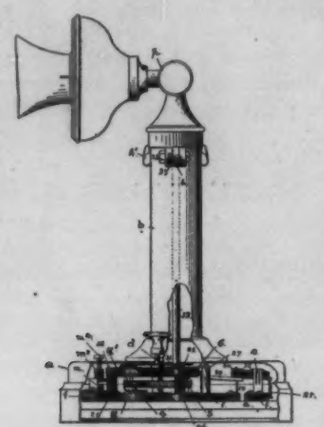
Means for receiving intelligence communicated by electro-magnetic waves, which comprises two substantially massive individual electrical conductors of different degrees of resistivity, and co-operatively having high resistivity, at least one of which conductors possesses high



resistivity; in combination with a spring which operatively holds the said conductors in substantially perfect small-areaed electrical contact with each other; and a freely movable, non-threaded support for said spring to permit a variation of contact pressure within wide limits of substantially perfect contact pressure, and thereby slightly vary the area of the minute electrical contact.

SWITCHING MECHANISM FOR TELEPHONE-CIRCUITS. 877,033. Albert K. Andriano, San Francisco, Cal., assignor to Direct-Line General Telephone Company, San Francisco, Cal.

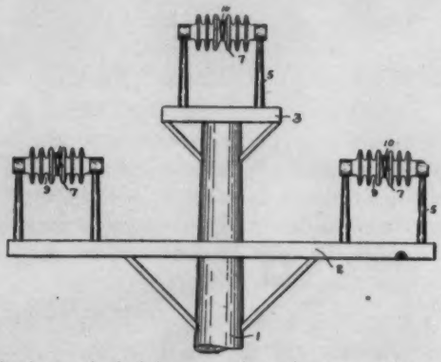
In a telephone switching-mechanism, the combination of two circular series of stationary-contacts in parallel planes one over the other, the contacts composing one series constituting separate terminals for individual lines, and a continuous contact-ring common to said contacts, insulated therefrom, the contacts in the other series comprising an inner plate having concentric and alternate salient and re-entering portions, and a surrounding ring



having corresponding but relatively larger salient and re-entering portions on the inner edge parallel with the corresponding portions on the inner ring, and separated therefrom; a rotatable switch-piece pivotally mounted between said upper series and lower series of contacts, and adapted to move in either direction, and contact-pieces on said movable switch-piece for making and breaking connection between the contacts in one series in alternate order to those in the other series by the same movement of the switch-piece.

INSULATOR. 876,939. Harold W. Buck, Niagara Falls, N. Y.

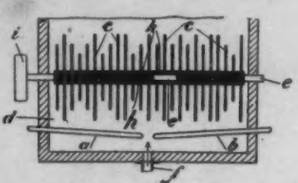
An insulator for electric conductors, comprising a cyl-



indrical body encircled by a series of corrugations and having a socket or recess formed in each end, and supports for body entering sockets or recesses and extending radially from body.

APPARATUS FOR MANUFACTURING NITRIC ACID OR OXID FROM AIR. 877,446. Harry Pauling, Gelsenkirchen, Germany.

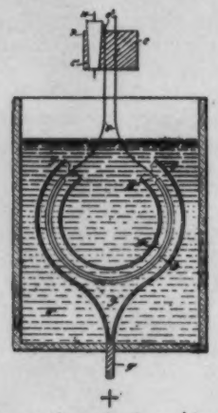
In an apparatus for manufacturing nitric acid or oxid from air, in combination, electrodes, arranged in a plane, for producing electric discharges, a number of plates so



disposed at one side of such electrodes as to cut the plane of the latter at right angles and form inter-spaces lying crosswise of the electrodes, means arranged at the opposite side thereof for blowing a current of gas through the space between the electrodes, and means for insulating the plates from each other.

MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS. 877,408. Francis M. F. Cazin, Hoboken, N. J.

A filament or luminant for electric incandescent lamps, composed primarily of a carbon-core, a thereon electrolytically plated coat of metals, of which the surface concentrical layer is oxidized on its surface—the several ma-



terials being so proportioned that after the luminant has been subjected to heat, it will consist of a central fillet of carbon, a concentrical layer of a mixture of carbon and metal, an adjoining layer of metal of the ruthenium-osmium-group—a layer of rare-metal oxidized on its surface.

INDUSTRIAL

MUELLER SCHOOL.

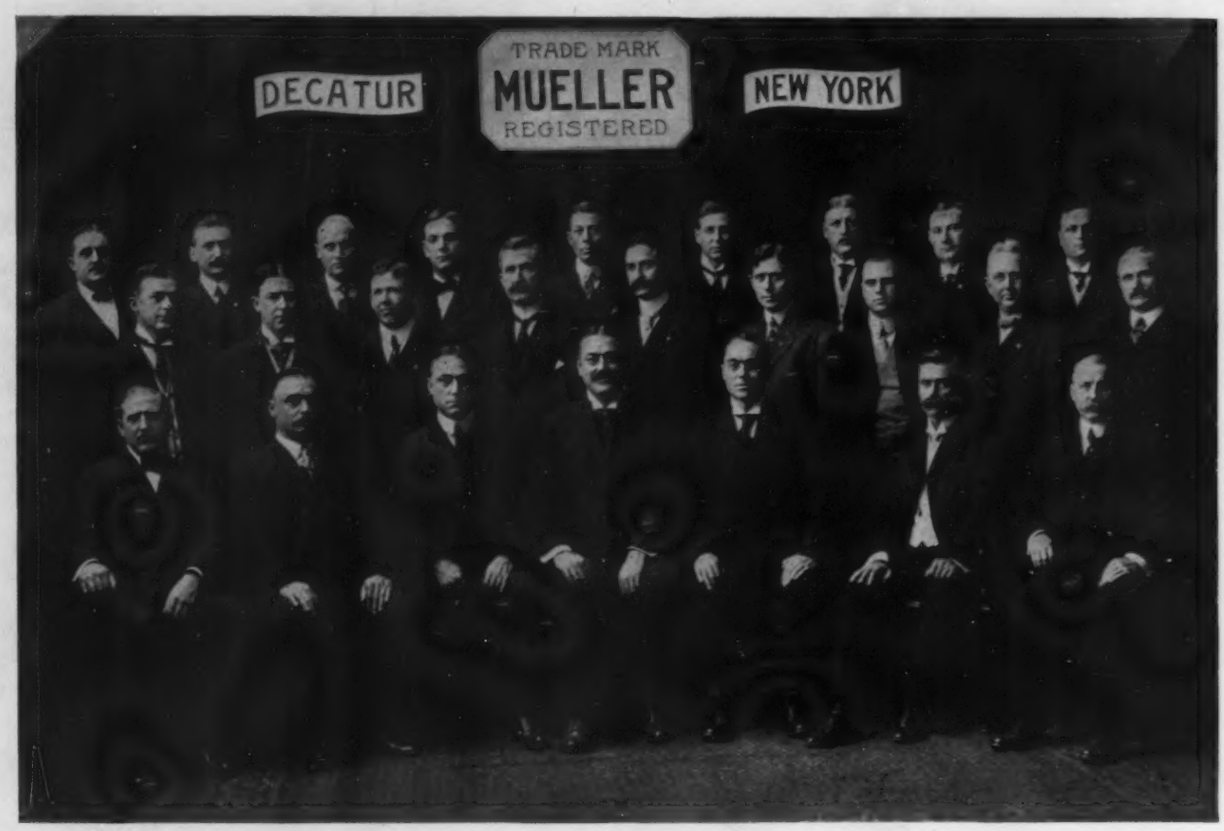
The traveling salesmen of the H. Mueller Mfg. Co., on January 11th, concluded their annual school of instruction which lasted two weeks, in the home office in Decatur, Ill.

Among other things to engage their attention, was the new nine-hundred-page catalogue, D, of water, gas and plumbing goods, now being sent out to the trade. The work on this very complete book was finished a few days before Christmas, and its delivery to the salesmen, who had anxiously anticipated it for a year, was greeted with cheers and applause.

Hennessy, Hastings and Fletcher sang as a solo and a trio, "I Got Mine." Much of the success of the initiation was due to Mr. Mon. T. Whitney, the president of the "49 Club," whose keen sense of humor and excellent powers of mimicry made him an ideal officer.

Following the revel of the club, the members, with a few invited guests, went to Strouse's Cafe, where a tempting banquet was served and toasts responded to. Mr. Adolph Mueller presided as toastmaster.

The "49 Club" elected Mr. F. J. Murphy as their president, to succeed Mr. M. T. Whitney. Cuts of these two gentlemen, who are well known to the trade, are shown herewith.



During the school of instruction, the catalogue was carefully reviewed and the goods discussed to bring out the best points. These schools of instruction have been prolific of good to the salesmen in the past, but the one just closed was voted by all as the most profitable. The sessions of the school were held daily from 9 to 12 and from 1:30 to 3:30, the president of the company presiding and all members of the company being present.

The salesmen found relaxation in their annual session of the "49 Club," held Tuesday evening, January 7th. There were three candidates for initiation—W. F. Hennessy, R. M. Hastings and E. D. Fletcher. Printed words are inadequate and impotent to convey an intelligent understanding of what really happened to the candidates during an uproarious hour and a half. When it was all over,

The following is a list of the salesmen of the Mueller Company, and the territory they cover:

Decatur Territory.

W. N. Dill, Pacific Coast, Idaho, Utah and Nevada.

Murray F. Kirkwood, part of Kansas, Nebraska, Colorado, part of Wyoming, and Western Iowa.

Frank J. Murphy, Southern Texas, New Mexico, Arizona, Old Mexico and Panama.

Scott E. Hamblin, Oklahoma, Indian Territory, Northern Texas, Southeastern Kansas.

W. B. Ford, Southern States, east of the Mississippi, and east point of Arkansas.

J. Arch Colbrun, Missouri, Southern Illinois, Arkansas, Southern Iowa, west point of Kentucky.

David E. Rowley, Southern Indiana, Eastern Illinois and Western Kentucky.

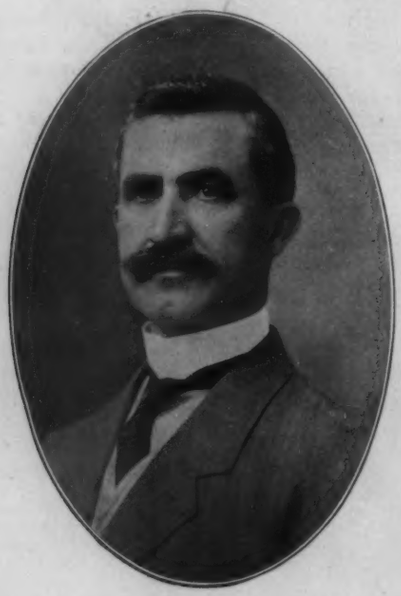
J. H. McCormick, Ohio and Eastern Kentucky.

James Smith, west of Pittsburg, West Maryland and West Virginia.

W. C. Heinrichs, Minnesota, North and South Dakota, Montana, Northern Wisconsin, Northern Wyoming, west of Upper Michigan, Manitoba and Northwest Territory.

Mon. T. Whitney, Northern Illinois, Southern Wisconsin and Northeastern Iowa.

H. F. Clark, Southern Michigan, Northwest corner of Ohio, Northern Indiana, Eastern part of Upper Michigan.



F. J. MURPHY, PRESIDENT "49-CLUB."

New York Territory.

R. M. Hastings, Northern Pennsylvania, Western New York.

E. D. Fletcher, Northern New Jersey.

W. F. Hennessy, New York City, Manhattan and The Bronx.

Geo. A. Caldwell, Maine, Rhode Island and Eastern Massachusetts and Eastern New Hampshire.

Al. F. Kice, Long Island and Brooklyn.

Arthur C. Pilcher, Western Massachusetts, Connecticut, Vermont, Western New Hampshire, and Northeastern portion of New York State.

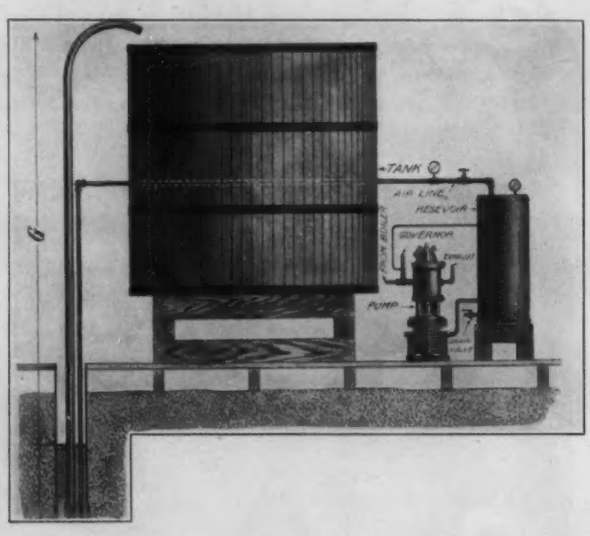
C. T. Ford, Delaware, Eastern Maryland, Virginia and a portion of North Carolina.

W. F. McCarthy, Southeastern Pennsylvania.

WESTINGHOUSE AIR COMPRESSORS FOR PUMPING AND CONVEYING LIQUIDS.

The advantages of employing compressed air for pumping water, oil and other liquids from wells, vats and tanks, are so pronounced that within the last few years this system has come into general use in a great variety of industries. Its simplicity and ease of maintenance make it far superior to any other means of conveying liquids. In deep wells particularly, great economy is found in the use of air as compared with the old-time deep-well pump. No valves, no reciprocating rods and plungers, and no wasteful steam cylinders at the well to operate them, are needed. The air system requires nothing but pipes properly proportioned as to size, length and connections, which, when once placed in position, remain indefinitely without need of attention or repairs. The air may be compressed in an existing power house, or at any convenient point, regardless of the distance from the well. Several separate wells, if desirable, can be pumped from one central station.

Westinghouse compressors, both steam and motor driven, have been found so well adapted to this class of service, that they are now extensively employed for compressing air to raise or convey liquids in breweries, tanneries, oil wells, dairies, hospitals, chemical laboratories, and acid plants, in addition to all kinds of water wells. Though the problem of pumping by compressed air with given conditions is a simple one, conditions differ so widely that it is impossible to arrive at a satisfactory solution by mathematical analysis. Results of actual tests are necessary to form a correct basis of figuring. Realizing this, and desirous of assisting their patrons in every possible way to obtain the best results, the Westinghouse Air Brake Company has lately completed a series of nearly 2,000 tests covering a range of from 350 to 400 different conditions of deep-well pumping, to obtain data concerning water delivered, air consumed and the best proportion and arrangement of piping and apparatus.



Heretofore tests have been made on wells having fixed conditions, and the results, covering a number of isolated cases, have been the only guide in considering the requirements for all other installations. In this case, however, the tests were made with a well driven on the premises of the Westinghouse Air Brake Company, specially fitted up for experimental work.

So far as is known, no such wide range of tests has ever before been made upon a single well. The results place the manufacturers in a position to be of great assistance to those desiring to install compressors for direct air pressure pumping.

The accompanying illustration shows the simple arrangement of piping used when the inside diameter of the well casing permits a discharge pipe and an air pipe, both of suitable size, to be placed side by side in the casing. Much additional information is given in a booklet (No. 9,006) published by the Westinghouse Air Brake Company, devoted entirely to the subject of pumping liquids by compressed air.

NEWS NOTES

FINANCIAL.

San Diego, Cal.—The stockholders have authorized an increase of the capital stock of the San Diego Electric Railway Company to the sum of $5,000,000.

Los Angeles, Cal.—The City Council has provided for issuing $510,000 of Owens River bonds. This is the second issue, and will be used to pay a large force of laborers.

Petaluma, Cal.—The Petaluma Power & Water Company, at its annual meeting, elected the following Directors: Henry Lawrence, Conrad Peohlmann, H. T. Fairbanks, M. Doyle and A. B. Hill. The president is A. B. Hill; vice-president, H. T. Fairbanks; secretary and superintendent, Fred Heseker.

Pasadena, Cal.—An ordinance has been passed by the City Council calling for a special election for February 20, for the purpose of voting bonds in the sum of $50,000 for municipal improvements. Among the improvements is the construction of lines of poles, wires and apparatus for the distribution of electric lights in the city.

San Francisco, Cal.—Patrick Calhoun, president of the United Railroads, who returned from the East recently, confirms the report that he has raised $5,000,000 to take up the company's floating debt, and to make many improvements. Among these is the construction of a power plant for the operation of the company's entire system, the reconstruction of tracks, and the general betterment of the service. About $2,000,000 of the $5,000,000 secured in New York has already been transmitted here. The company paid $325,000 in city and county taxes last week.

Los Angeles, Cal.—The District Attorney holds that the Los Angeles Railway Company must pay the $43,000 tax on its franchise. The railroad company, which maintains its headquarters in San Francisco, will now file suit to test the validity of the law by which a tax is imposed on its State franchise, and will press it to the highest court. If the corporation should lose, the point will be raised whether the City and County of San Francisco, where it has its principal offices, is not entitled to the franchise tax, rather than Los Angeles County, where it operates.

San Francisco, Cal.—By the terms of a deed of trust for $45,000,000, filed January 30, the Pacific Gas & Electric Company completes control of the gas and electric plants in twenty-five counties of California, including San Francisco, Alameda, Santa Clara, Sacramento, Alpine, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Marin, Napa, Nevada, Placer, Plumas, San Joaquin, San Mateo, Santa Cruz, Solano, Sonoma, Sutter, Tuolumne, Yolo and Yuba counties. The consolidation of all the gas and electric plants was effected by a transfer to the California Gas & Electric Corporation of all the property and franchises of the following companies: Oakland Gas, Light & Heat Company; Oakland Equitable Gas Company; Berkeley Electric Lighting Company; Bay Counties Power Company; Valley Counties Power Company; Yuba Electric Power Company; Nevada County Electric Power Company; Butte County Electric, Power & Light Company; Standard Electric Company, of California; Stockton Water Company; Blue Lakes Water Company; Sacramento Electric, Gas & Railway Company; Central Electric Railway Company; San Mateo Power Company; United Gas & Electric Company, and the shares of stock of the South Yuba Water Company. The California Gas & Electric Corporation has also filed a certificate of the increase of its capital stock from $15,000,000 to $50,000,000, besides the increase of bonded indebtedness from $10,000,000 to $45,000,000.

TELEPHONE AND TELEGRAPH.

Modesto, Cal.—J. D. Harp has asked and received permission from the Board of Supervisors, to erect and maintain a telephone line along the Crows Landing road.

Santa Rosa, Cal.—Plans for the new telephone building which is to be erected on Third Street by Alfred Trembley in the near future for the Pacific States Telephone Company have been submitted to the company. It will occupy forty feet on Third Street, running through the block, and be equipped with a new plant.

San Francisco, Cal.—The police and fire commissions have decided to suspend further manufacture of fire alarm boxes in the department shop. The majority of the commissioners believe it will be cheaper to purchase from time to time such boxes as may be needed, the proposition being to dispense with the services of about eight men by stopping the home manufacture.

San Francisco, Cal.—The new telephone service which has been installed by the Pacific States Telephone & Telegraph Company to connect Oakland, Alameda and Berkeley with San Francisco direct, was put into operation this week. The system was completed some days previous, but the management waited before opening the new lines to the public, to complete the distribution of a new telephone directory. This will combine the telephone numbers for San Francisco, Oakland, Alameda and Berkeley.

INCORPORATIONS.

Chico, Cal.—The Feather River Power Company has filed articles of incorporation here, the capital stock being $1,000,000, and the incorporators, A. E. Boynton, S. A. Moss and C. F. Meteer.

Ukiah, Cal.—The Clear Lake Telephone & Telegraph Company has filed articles of incorporation here, the capital stock being $50,000 and the incorporators H. S. Johnson, A. H. Spur, L. J. Shuman, M. S. Sayre and F. L. Wright.

Hanford, Cal.—The Corcoran Water & Gas Company has been incorporated with a capital stock of $50,000 by E. O. Hanson, A. H. Potter, R. V. Milner, L. S. Randolph, J. B. Mayer, Geo. Hanna and J. W. Guiberson.

Bakersfield, Cal.—The Fairbanks Oil Company, of Berkeley, has filed its articles here, with a capital stock of $25,000, J. C. Morrison, M. P. W. Albee, William J. Acheson, Francis Ferrier and H. W. Fairbanks being the directors.

Los Angeles, Cal.—Articles of incorporation have been filed by W. S. Collins, E. L. Geraldine, C. H. Collins, J. C. White and C. R. John, as directors for the Geraldine Tract Water Company. The company is capitalized at $30,000.

Hanford, Cal.—The proposed Granger electric railway enterprises in this county have been incorporated as the Hanford & Lemoore Inter-Urban Railway Company, by Mr. Granger and his associates. The capital stock is placed at $1,000,000.

Napa, Cal.—Articles of incorporation of the Vallejo Irrigation & Power Company have been filed here. The life of the corporation is for fifty years, and its principal place of business is Napa. The first board of directors are: Joseph A. Migliavacca, E. W. Doughty, W. G. Thompson, L. E. Johnson and Harry L. Johnson, all of this city. The company is capitalized at $500,000.

Reno, Nev.—The North Yuba Electric Light & Power Company has filed articles of incorporation here. The capital stock of the company is $1,000,000, and the incorporators are Samuel B. Crane, William B. Barstow and Earl Talbot. The company plans to build a power plant on the North Yuba River, and to supply electricity to various towns and localities in California and Nevada.

TRANSMISSION.

Oakland, Cal.—The Supervisors have granted a franchise to erect poles and string wires throughout the county, to E. M. Downer, of Pinole, for the conveyance of electricity to be used for any purpose except telephones and telegraphs. The California Railway was given a franchise to construct an electric railroad from Fulton Street, near Lloyd Avenue, to Washington Avenue, and thence to the right of way of the Southern Pacific Company.

Riverside, Cal.—A permit has been granted by the Board of Supervisors to the Corona Gas & Electric Company, to erect and maintain a pole and electric transmission line over certain roads and highways in Riverside County.

ILLUMINATION.

Banning, Cal.—A company capitalized at $25,000 has been organized here, to put in a gas plant. C. D. Hamilton is president, and Dr. J. C. King, secretary. The plant is to be started at once.

CLASSIFIED LIST OF ADVERTISERS

Air Compressors
Hunt, Mirk & Co.
Alternators
California Electrical Works
General Electric Co.
Aluminum Electrical Conductors
Pierson, Roeding & Co.
Annunciators
Electric Appliance Co.
California Electrical Works.
Sterling Electric Co.
Partrick, Carter & Wilkins Co.
Asbestos Products
Johns-Manville Co., H. W.
Bases and Fittings
Chase-Shawmut Co.
Batteries, Primary
California Electrical Works
Standard Electrical Works
Batteries, Storage
Western Electric Co.
Sterling Electric Co.
Electric Storage Battery Co.
Boilers
Moore, C. C. & Co., Inc.
Standard Electrical Works
Tracy Engineering Co.
Hunt, Mirk & Co.
Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.
Buffers
Northern Electrical Mfg. Co.
General Electric Co.
Building Material
Johns-Manville Co., H. W.
Building Paper
Johns-Manville Co., H. W.
Cable Clips and Hangers
Chase-Shawmut Co.
Circuit Breakers
Fort Wayne Electric Works
Electric Appliance Co.
Sterling Electric Co.
General Electric Co.
Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
C. H. Wheeler Mfg. Co.
Conduits
American Circular Loom Co.
Electric Appliance Co.
Sterling Electric Co.
Conduit and Moulding Hangers.
Chase-Shawmut Co.
Conduit Fixtures
Sterling Electric Co.
Electric Appliance Co.
Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.
Cross Arms
Sterling Electric Co.
Electric Appliance Co.
Dynamos and Motors
Brooks-Follis Elec. Corp.
California Electrical Works
Crocker-Wheeler Co.
Electric Appliance Co.
Sterling Electric Co.
Fort Wayne Electric Works
General Electric Co.
Holtzer-Cabot Elec. Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Elevators
Van Emon Elevator Co.
Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.
Electric Grinders
California Electrical Works
General Electric Co.
Northern Electrical Mfg. Co.
Electric Heating Devices
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Electrical Instruments
Electric Appliance Co.
Cutter Co., The
Sterling Electric Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Electrical Machinery
Crocker-Wheeler Co.
California Electrical Works
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Electric Polishers
Northern Electric Mfg. Co.
Electric Railway Appliances
Pierson, Roeding & Co.
General Electric Co.
Johns-Manville Co., H. W.
Electrical Supplies
California Electrical Works
Sterling Electric Co.
Electric Appliance Co.
General Electric Co.
Standard Electrical Works
Johns-Manville Co., H. W.
Chase-Shawmut Co.
Electric Ventilating Fans
Sterling Electric Co.
California Electrical Works
General Electric Co.
Northern Electrical Mfg. Co.
Engines, Boilers, Heaters, etc.
Moore, Chas. C. Co., Inc.
Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.
Standard Electrical Works
Tracy Engineering Co.
Westinghouse Machine Co.
Hunt, Mirk & Co.
Engines, Gas and Gasoline
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.
Hunt, Mirk & Co.
Engineers and Contractors
Brooks-Follis Elec. Corp.
California Electrical Works
Hunt, Mirk & Co.
Sterling Electric Co.
Copeland, Clem A.
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Jackson, D. C. & W. R.
Smith, Emery & Co.